

Enhancing Academic Achievement And Retention In Senior Secondary School Chemistry Through Discussion And Lecture Methods: A Case Study Of Some Selected Secondary Schools In Gboko, Benue State, Nigeria

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Abstract

The present study was initiated to determine how academic achievement and retention in chemistry is enhanced using the two instructional methods among SSII students and ascertained the differential performance of male and female students in chemistry with a view of improving student performance in chemistry. The study adopted a non-equivalent pretest, posttest control quasi-experimental design. A total of one hundred and eighteen senior secondary school II students in intact classes were chosen from three schools in Gboko Local Government Area of Benue State using purposive random sampling. The ages of the students ranged between 16-17 years. Data were collected using a 30-item multiple choice Chemistry Achievement Test (CAT), in organic chemistry. Students were assigned to a treatment and a control group. Three hypotheses were generated and tested which were tested at 0.05 level of significance. The data obtained were analyzed using descriptive statistics, t-test, spearman's correlation coefficient and analysis of variance (ANOVA). There was significant difference in students performance when discussion and lecture strategies were used to teach chemistry ($F_{cal} = 4.65 > F_{crit} = 3.85$ at $P < 0.05$). There was significant difference in the retention ability of students exposed to discussion and lecture method ($r_{cal} = 0.9786 > 0.2353$ at $P < 0.05$). There was significant difference in the performance of male and female students in the two groups ($t_{cal} = 3.621 > t_{crit} = 2.000$ at $P < 0.05$). The overall results showed that discussion instructional strategy significantly improved students' performance in chemistry better than the lecture instructional strategy. The study concluded that discussion enhanced better achievement and productivity than the lecture method. It was recommended that discussion method should be used to teach organic chemistry in Nigerian Senior Secondary Schools.

Keywords: discussion method, organic chemistry, lecture method, achievement

1. Introduction

The role of chemistry in our daily and national life as well as in the industry is undaunted. Many of our day-to-day activities revolve around chemistry. Chemistry is everywhere; chemistry is life; chemistry is the oracle and crown prince of modern science (Oloyede, 2010; Opara and Waswa,2013). Despite the key role of chemistry as the central science that forms the basic foundation to many disciplines and in improving the quality of life, the performance of Nigeria secondary students in the subject has for many years remained a matter of a serious concern (Jegede, 2010; Oloyede, 2010).

Efforts made through research to discover the causes of the persistent failure revealed among others, that secondary school chemistry teachers mainly adopt the lecture method in the teaching and learning of chemistry(Udoh,2008). Lovat(2003) posit that "teaching is not an incidental craft to follow naturally from mastery of subject content, but a highly complex blend of theoretical understanding and practical skill". Emphasis on traditional approaches and coverage of content mapped out in the school syllabus and scheme of work for the three years of senior secondary education (Nigeria runs 6-3-3-4 system on education although with the recently introduced 9-3-4 system the senior secondary position has not changed) in Nigeria have resulted to students learning chemistry without conceptual understanding (Bennet, 2003; Jodi,2010).

Meaningful learning occurs when learners comprehend concepts and are able to connect them with previous

knowledge (Ausubel, 2000 and Omolade, 2008) . When students learn chemistry meaningfully, their ability to reflect on their own learning and make adjustments accordingly fosters deeper learning. Deeper learning is the key strategy through which students find meaning and understanding from course material and experiences (Warburton, 2007). This in turn may result to competence of knowledge transfer to other domains and how to apply the knowledge in answering questions and resolving problems (Pellegrine and Hilton,2012).

However, record of analysis of students' results in Chemistry and other science subjects such as Physics and Biology for a number of years has revealed dismal failure, with Chemistry being the poorest(WAEC Ann. Report, 2010- 2014).

Research has shown that students do not enter the classroom as a “blank slate” (Pinker, 2003). Learners construct knowledge by making connections between new information and their existing conceptual network. Piaget (1964) noted that “learning is an active process of knowledge construction, the making of connections between existing network of knowledge”. According to Bybee (2009), students' prior conceptions, ideas and experiences which they carry to the classroom influence the way they learn new concepts and skills . Hence, it is important that they are actively engaged in the learning process and that they are challenged to reflect on their own learning besides being able to link their prior knowledge to new knowledge. Recent studies done in Nigeria (Eze,2002; Egbo,2005;Oludipe and Awokoya,2010;Ameh and Dantani ,2012;Opara and Waswa,2013 and Muhammad,2014) suggest that teachers are in a hurry and tend to rush through the scheme of work to enable them cover the topics in the curriculum within the given period.

Discussion method is defined as a step by step procedure of teaching specific aspect of subject in other to get the desired objectives (Vighnarajah et al., 2008). The method is suitable for mainly for topics that are debatable and problematic. It is a method that utilizes guided interaction to highlight a particular subject matter with the aim of facilitating the participants. Apart from the fact the method is time consuming, it enhances learning by giving the learners room to develop their communicating skills, mental skills such as critical thinking , reflective thinking and evaluating diverse opinion (Jegede, 2012).The role of the teacher where discussion method hold sway is that of a facilitator. The teacher encourages the learner to discover things for themselves. Despite the several research evidence in favor of the discussion methods, there is as yet little or no study in Benue state, Nigeria to examine how it will impact on students' achievement and retention in chemistry irrespective of the decrying persistent failure in the subject.

It is in the light of this development that the present study was initiated to determine how academic achievement and retention in chemistry is enhanced using the two instructional methods.

2. Purpose of the study

The purpose of the study was to determine the effect of discussion and lecture method on students' achievement and retention in chemistry Gboko, Benue State, Nigeria. Specifically, the study sought to:

1. determine the achievement scores of students taught chemistry with discussion and lecture methods.
2. determine the academic achievement scores and retention of male and female students in chemistry when taught with discussion and lecture methods.

3 Research questions

Three research questions were posed for the study:

- (1) What are the mean achievement scores in chemistry tests of secondary school students taught some selected chemistry topics through the discussion and those taught using lecture methods?
- (2) What is the effect of gender on mean achievement scores in chemistry tests of secondary school students taught selected chemistry topics through the discussion and those taught using lecture methods.
- (3) To what extent do students recall when taught using lecture and discussion methods

4. Research hypotheses

Two null hypotheses were formulated at 5% level of significance as follows:

H_{o1} There is no significant difference in the mean achievement scores of students taught selected chemistry topics through the discussion and those taught by lecture methods.

H_{o2} There is no significant difference the mean achievement scores of boys and girls taught selected chemistry topics using the discussion and lecture methods.

H_{o3}. There is no significant difference in the mean retention scores between students taught using lecture and discussion methods.

5. Methodology

Research design

A quasi experimental, the non-equivalent control group design was used for the study, since there was no randomization of the subjects into groups. Thus intact groups which were already organized into classes, were

used.

5.1 Population

The population of the study is comprised of SSII science students in the 27 public senior secondary schools that offer chemistry in the Gboko Educational Zone of Benue State. The population comprises of single sex and co-educational schools. There are 9 male Schools, 6 female Schools and 12 coeducational schools in the population. The total number of students in the population of those offering chemistry were 3,101, comprising of 1,965 males and 1,136 females respectively..

5.2 Sampling Technique

One hundred and eighteen students served as sample for the study from three schools within Gboko metropolis. As gender is one of the variables in the research, purposive sampling procedure was adopted to ensure subjects chosen that is both male and female had similar background, experience and exposure to similar infrastructure.

5.3 Instrumentation

Two instruments were used for the study. This was the chemistry achievement test (CAT) and chemistry retention test (CRT) respectively. This consists of 20 multiple choice item and short answer type questions carefully drawn from past WAEC and NECO past question papers and from the investigator's design who is also a specialist in chemistry. Before administering the test items, the questions were subjected to content and face validity by other experts in chemistry so as to ascertain their appropriateness. The reliability coefficient was computed using Pearson-product moment correlation method and the value was $r= 0.87$. This indicate that the test was reliable and as such would test what it was out to test.

5.3.1 Pretest session

Before the commencement of the main treatment which lasted for 8 weeks , the subjects in the experimental and control groups were given the CAT based on the topics selected for the study. This is to determine the equivalence of the two groups.

5.3.2 Instructional Procedure: Nomenclature of compounds in Organic chemistry was the topic used in the study. The control group was taught using traditional methods of lecture and experimental group was taught using the discussion method that created maximum room for interaction in groups.

5.4 Data Analysis

At the end of the main treatment, the instrument earlier on described were administered so as to assess the effectiveness of the two teaching method under investigation. Scores from the experimental and control groups form the data for the study. Data were analyzed using mean, standard deviation, t-test and ANOVA statistical tool at $P<0.05$.

5.5 Chemistry Retention Test

The CAT was rearranged and reshuffled and administered as CRT two weeks after the main treatment session. Mean scores of students were ranked and analyzed through spearman's rank correlation coefficient.

6. Results

Research question 1: What are the mean achievement scores in chemistry tests of secondary school students taught some selected chemistry topics through the discussion and those taught using lecture methods?

Table 1: Relative Students' Mean Achievement Scores in CAT with Discussion and Lecture methods

Group	Symbol	Pretest	Posttest	Mean gain Difference
Discussion Method (Experimental method)	N	59	59	
	X ₁	15.45	25.78	10.33
Lecture Method (control)	SD	3.75	4.02	
	N	59	59	
	X ₁	14.93	21.67	6.74
	SD	3.40	3.56	

N= Number of students X₁ = Mean, SD = Standard Deviation

Table 1 shows that the standard deviation of 3.75 for the experimental group as against 3.40 for the control

group showed that the range of scores between the experimental and control group from the pretest CAT was very narrow. This suggest that the group were equivalent subject to treatment. The posttest mean scores for the experimental students improved appreciably from 15.45 to 25.78 while their standard deviation shows a marginal increase. For the control group, it was an improvement from a mean score of 14.93 to 21.67 and also a marginal increase in standard deviation . When compared with the experimental group, it was low. The table also shows that the mean gain difference was 10.33 for discussion method and 6.74 in lecture method. This implies that subject taught with discussion method performed better in the achievement test than those taught with lecture method.

Table 2: Analysis of variance of Mean Achievement Score in CAT with Discussion and Lecture methods

Source of Variance	Sum of squares	df	Mean square	F	Significance level at 0.05
Discussion & Lecture Methods (DM & LM)	152.14 ²	1	23146.89	4.65	3.85
Group (Methods)	-70.54 ²	1	4975.89		
Total	81.59 ²	117	6656.93		

Table 2 above shows the achievement scores of students taught DM and LM with the table F-ratio at 0.05 level of significance to find out if the hypothesis is accepted or not. The calculated F-ratio between discussion method (experimental method) and lecture method (control) was found to be 4.65 and the table F-value at 0.05 level of significance was 3.85. This implies that $F_{cal} > F_{crit}$ i.e the calculated F-ratio was greater than table F-value at 0.05 level of significance, the stated null hypothesis is therefore rejected meaning there was significant difference between the mean achievement scores of students taught with discussion method and lecture method.

Research question 2: What is the effect of gender on mean achievement scores in chemistry tests of secondary school students taught selected chemistry topics through the discussion and those taught using lecture methods ?

Table 3 : Relative Students' Mean Achievement Scores of Boys and Girls in CAT with Discussion and Lecture methods

Group	Symbol	Pretest	Posttest	Mean gain Difference
Discussion Method (Boys) (Experimental method)	N X ₁ SD	32 15.75 3.25	32 29.98 4.32	14.23
Discussion Method (Girls) (Experimental method)	N X ₁ SD	27 16.45 3.65	27 25.58 5.02	9.13
Lecture Method(Boys) (control)	N X ₁ SD	32 14.73 3.73	32 25.87 4.57	11.14
Lecture Method (Girls) (control)	N X ₁ SD	27 15.03 3.21	27 20.67 3.36	5.64

N= Number of students X₁ = Mean, SD = Standard Deviation

Table 3 shows that the pretest means scores of students taught with the two methods of teaching i.e. discussion (experimental method) and lecture method (control) were found to be 15.75 and 14.73 for boys and 16.45 and

15.03 for girls respectively; while the post test results shows 29.98 and 25.87 for boys and 25.58 and 20.67 for girls respectively. These results show there is a difference between the students pretest and post-test scores in each method of teaching. The difference is highest with discussion and lowest with the lecture method. The mean gain differences for boys are 14.23 for the discussion method and 11.14 for the lecture method and for the girls the mean gain scores are 9.13 and 5.64 in each method respectively. The results further shows that the difference in posttest mean score is highest among boys and girls students taught with discussion method and least by those taught with lecture method. In the case of variability of test scores, the standard deviation obtained in each case showed a minimal spread of scores. It was also noticed that there was a little increase in the posttest mean scores for female students taught with discussion and lecture methods.

Table 4 Independent t-test for boys and girls in control group post test

Group	Mean	S.D	df	t _{cal}	P _{0.05}
Boys	32	25.87	4.57	57	4.906
Girls	27	20.67	3.36		2.000

The results showed that t - test of post test scores for boys and girls in the control group is significant because 4.906 is higher than 2.000. That is, the null hypothesis of no significant gender effect is rejected. Therefore, there is significant combined effect of teaching method and gender on students' achievement scores in the chemistry tests.

Table 5: Independent t-test for boys and girls in experimental group post test

Group	N	Mean	S.D	df	t _{cal}	P _{0.05}
Boys	32	29.98	4.32	57	3.621	2.000
Girls	27	25.58	5.02			

The results showed that t - test of post test scores for boys and girls in the experimental group is significant because 3.621 is higher than 2.000. That is, the null hypothesis of no significant gender effect is rejected. Therefore, there is no significant combined effect of teaching method and gender on students' achievement scores in the chemistry tests.

Research question 3: To what extent do students recall when taught using lecture and discussion methods ?

Table 6: Correlation coefficient of ranked retention scores between students taught using discussion and lecture method

Group	N	r _{cal}	r _{critical} (P< 0.05)
DM	59	0.9786	0.2353
LM	59		

Result in table 6 shows that $r_{cal} > r_{crit}$, i.e. 0.9786 is greater than 0.2353. The null hypothesis 3 is rejected and so there is significant difference in the mean retention scores between students taught using lecture and discussion methods.

7. Discussion

The results of this study provided an empirical evidence of the efficacy of the discussion method in the teaching of organic chemistry. The experimental group produced higher mean achievement scores than the control group taught the same content/concepts in chemistry using the lecture methods. The findings of this study is on all fours with those of earlier investigators that teaching chemical concept with activity-oriented strategies can impact significantly on students' retention, achievement and understanding (Eze,2002; Egbo,2005 and Omwirhiren,2005).

The importance of deeper learning as a means of developing learners' capacity to apply knowledge gained during the learning process to problem solving was reflected in this study since the students taught through the discussion method demonstrated their understanding of the concepts during the evaluation phase. Students' active participation, their interaction in groups and the teacher's role as provider of thought provoking questions might have enhanced students' achievement gains in the chemistry tests as established by Moyer et al(2007). The result of this study showed that there is significant difference in achievement between male and female students in the experimental group taught selected topics in organic chemistry using the discussion method. As for the influence of gender on students' academic achievement, science educators differ in their findings. For instance, Aluko (2005), Nbina and Avwiri (2014) and Muhammad(2014) in separate studies, reported that gender has no effect on student achievement in science while Lawal (2009) found that female subjects were significantly better than their male counterparts and that there was a significant difference between the male and female subjects in their ability to evaluate science concepts. Also Omwirhiren(2013) and Daluba(2013) noted that the male perform

significantly better than their female counterparts in evaluating science concepts. The consensus among science educators is that some instructional strategies are gender bias while some are gender friendly, however, the degree of gender related differences in learning vary from one method of instruction to the other as well as the concept being learnt.

8. Conclusion and Recommendations

Findings from present study indicate that secondary school students performed differently when taught with the discussion and lecture methods. Students' performance in the lecture group is lower than those in the experimental group (discussion method) as they learnt the selected concepts with difficulty. Boys performed significantly better than the girls when taught with both the experimental and control methods. Finally, there was a significant difference ($P < 0.05$) in the academic achievement scores and retention of students taught chemistry with the discussion and lecture methods.

Based on the findings and conclusion of the study, the following recommendations were proffered:

1. Secondary school teachers should be discouraged from the continuous use of lecture method in the teaching of chemistry as the method make students performed poorly in chemistry.
2. Attention should be adequately paid to the female folds by advising teachers of chemistry to effectively employ the use of discussion method in a way that it will help improve female students performance in chemistry. This is because the result of the study have shown a significant difference in their mean achievement scores in favour of males,
3. To further enhance performance and retention in the learners, teachers should make conscientious efforts to integrate discussion method into the teaching of perceived difficult topics chemistry in secondary schools. This will go a long way in diffusing the abstractness of most chemical concepts.
4. More topics in chemistry (such as mole concept, electrolysis, energetics among others) should be tested using the discussion method in the teaching and learning of chemistry so as to compare findings.

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